Space Weather Technical Forecast

Issued on Friday, 29 September 2023 at 01:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing chance of isolated M-flares (R1-R2 Radio blackouts). Chance of G1-G2 (Minor to Moderate) geomagnetic storms on Day 3 (01 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been at Moderate levels. The largest flare was an M1.2 flare at 28/0907 UTC from AR3450 in the southeast quadrant.

There are currently eight sunspot regions on the visible disc, with five of these located in the western hemisphere. Most regions are small, weak and magnetically simple, and either stable or gradually decaying. However, AR3450 has the potential to be moderately magnetically complex, more so than it's current classification of Dao/beta would indicate, but is currently too close to the southeast limb for clear analysis.

No potential Earth-directed CMEs have been observed in the past 24hrs.

Solar Wind / Geomagnetic Activity: Solar winds as observed at DSCOVR/ACE started at slightly elevated levels, peaking at 479 km/s at 28/0135 UTC. After this there was a general, and erratic, decline to background levels until the evening, when a slight increased occurred with wind speeds returning to slightly elevated levels again. This later increase may have been the result of a weak passing CME, possibly the CME which left the Sun on the 24th. Density remained below average. The interplanetary magnetic field (IMF), Bt, was predominantly weak but did briefly reach moderate values of 8 nT during the evening. The north-south component (Bz) also varied weakly, ranging from +3nT to -4nT. Phi angle remained positive (away from the Sun). Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was predominantly at Moderate levels, but did briefly reach High levels at the peak of the diurnal cycle, reaching 1186 pfu at 28/1650 UTC. Associated 24-hour fluence remained just below the Active (1e8 integrated pfu) threshold, initially on a steady trend but then later in the day a gradually declining trend. The observation at 29/0001 UTC was 5.11e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to remain at Low to Moderate levels, with further isolated M-class flares possible, most likely from the regions in the eastern hemisphere.

Solar Wind / Geomagnetic Activity: A possible glance from a weak CME arrival cannot be ruled out later today or early tomorrow, however this is deemed very low confidence. Otherwise no CMEs feature in the current forecast period. Today and tomorrow the solar wind is expected to be at background to slightly elevated levels, initially under the residual influence of a probable weak CME arrival, and thereafter with possible weak coronal hole influence.

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A more significant, recurrent coronal hole (CH54/+) is anticipated to arrive at Earth during Day 3 (1st Oct), and then persist through day 4 (2nd Oct) with slightly elevated to perhaps elevated speeds.
Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 0-3) today and tomorrow. From Day 3 (1st Oct) activity is expected to increase to Unsettled to Active (Kp 3-4) levels, with a chance of G1-G2/Minor-Moderate Storm (Kp 5-6) intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with a daily very slight chance of an enhancement should any larger flares occur.
High energy electron flux (greater than 2MeV) is likely to be at predominantly Moderate levels today and tomorrow, but briefly reaching High levels at the peak of the diurnal cycle, especially today. By day 3 (1st) mainly background levels are expected, followed by an increase in levels occurs during day 4 (2nd) due to the arrival of a HSS. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated flux).

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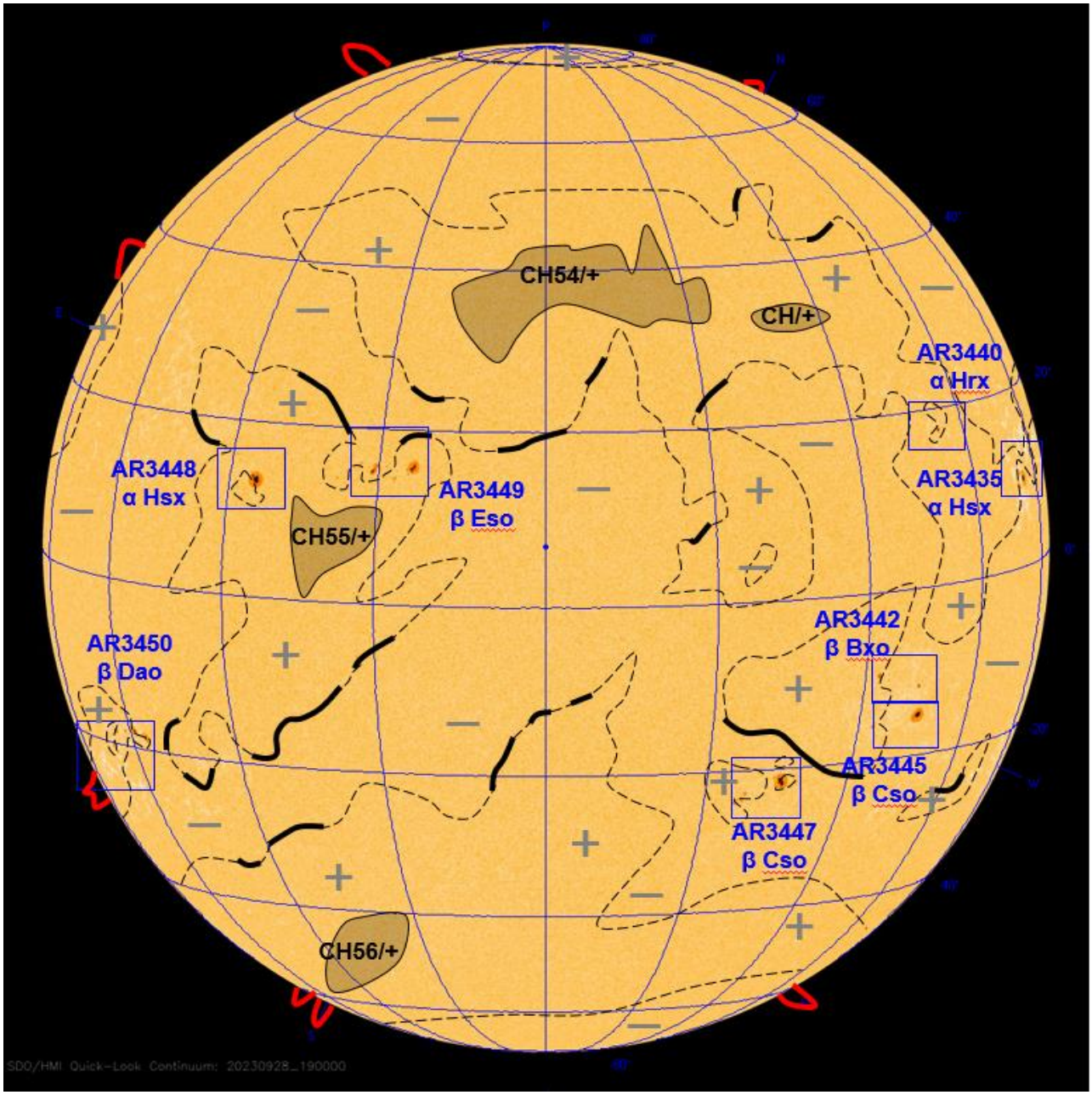
Figure 1. Solar Analysis Valid 28/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME remains in the forecast, with a very low probability of causing a glancing blow at Earth, from a filament eruption from the northwest quadrant on 25/1540 UTC. Analysis of this CME was tricky with a lack of available imagery due to spacecraft manoeuvres, with a very slight glancing blow late today (29 Sep) or early tomorrow deemed possible.
Today and tomorrow the solar wind is expected to be at background to slightly elevated levels, initially under the residual influence of a probable weak CME arrival, and thereafter with possible occasional weak coronal hole influence. A more significant, recurrent coronal hole (CH54/+) is anticipated to arrive at Earth early Day 3 (1st Oct), and then persist through the remainder of the forecast period, bringing slightly elevated to perhaps elevated speeds.
Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 0-3) today and tomorrow. From Day 3 (1st Oct) activity is expected to increase to Unsettled to Active (Kp 3-4) levels, with a chance of G1-G2/Minor-Moderate Storm (Kp 5-6) intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	40	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections – None expected.

Figure 2: Met Office Enlil ensemble, showing pertubations indicating the slight chance of a weak CME arrival today.

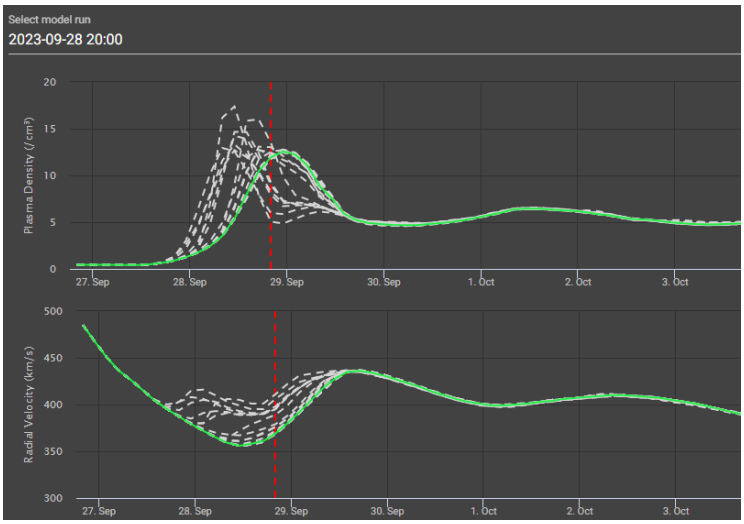

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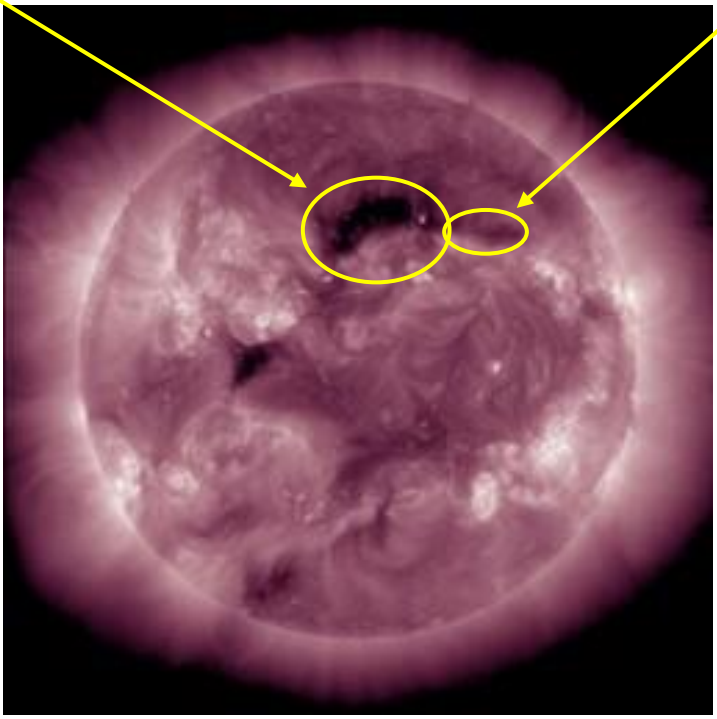
Figure 3: Latest SDO/AIA 211 image showing coronal holes; a weak feature ahead of CH54.



Radio Blackouts - X-Ray Flares:

Solar activity has been at Moderate levels. Over the past 24 hours the largest flare was an M1.2 event peaking at 28/0907 UTC, originating from AR3450.
There are currently eight sunspot regions on the visible disc, with five of these located in the western hemisphere. AR4350 is potentially the most magnetically complex group, but as it is located in the far southeast it remains tricky to analyse. It may well have a greater complexity than the current Dao/beta classification indicates, as the region maintains a couple of small-moderate sized lead spots with asymmetrical penumbra, plus a number of small trailing spots containing what appears to be rudimentary penumbra. AR3449 in the northeast has elongated slightly to become an Eso/beta. Meanwhile the remaining regions are small and/or magnetically simple at this time, with no or little change.

Activity should remain at Low to Moderate levels with an ongoing chance of isolated M-flares, these most likely from AR3450.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is likely to persist at background levels, however with five active regions moving across the western disc there is a very slight chance that any significant flares could produce an S1 or greater event.

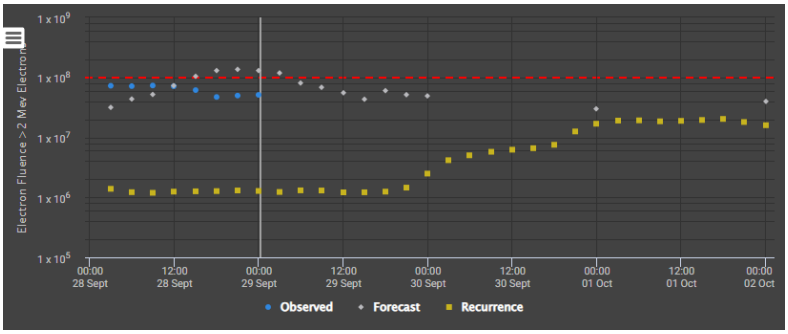
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) observed by GOES16 has been varying between Moderate to High. The high energy electron flux is likely to be at predominantly Moderate levels today and tomorrow, but briefly reaching High levels at the peak of the diurnal cycle, especially today. By day 3 (1st) mainly background levels are expected, followed by an increase in levels during day 4 (2nd) due to the arrival of a HSS from CH54.
The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated flux), as indicated by the Met Office REFM. However, instead of the steady trend that is currently shown by the REFM, a gradually decline is preferred over the next 3 days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	10	1	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Met Office REFM model.



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